THE AMERICAN
JOURNAL OF PHARMACY

APRIL, 1909

THE STORY OF A PIECE OF PITCHBLENDE.[1]

By Harry F. Keller, Ph.D.[2]

Not long ago, after a somewhat dull meeting of one of our scientific societies, a little coterie among the members agreed to hold an informal symposium on some topic of more general interest. Quite a number of subjects had been suggested only to be dismissed as not suited for the occasion, when one of the gentlemen made a ten-strike by proposing that every one present give his views as to which mineral substance should be regarded as the most interesting component of the earth's crust. The motion was carried unanimously, and the discussion that followed continued into the small hours of the morning.

It may be doubted whether a stenographic report of the proceedings, set up in type, would prove entirely satisfactory to the several speakers, but "the way they heaved those fossils" certainly made more pleasing impressions than that indulged in by the members of the "Society upon the Stanislaus" in Bret Harte's poem, and all went home with the feeling of having assisted at a most profitable and entertaining séance.

[1] A post-graduate lecture given under the auspices of the Philadelphia Branch of the American Pharmaceutical Association at the Central High School, Philadelphia.

[2] I would gratefully acknowledge here the kind permission of Messrs. Munn & Co., publishers of the *Scientific American*, William J. Hammer, Esq., of New York, and Prof. Arthur W. Goodspeed, of the University of Pennsylvania, to use some of the portraits and radiographs with which this lecture was illustrated.—H. F. K.

A prominent metallurgist was the one to open the debate. In a snappy and interest-compelling manner he gave an account of the principal ores of iron, their occurrence in nature and their economic importance, and he vividly depicted the various processes by which the most useful of the metals—iron and steel—are extracted from these earthy substances.

He was followed by a mineralogist, well known for his contributions to crystallography and crystal-physics. While conceding that the iron ores had perhaps few rivals among the useful minerals, and that the metal obtained from them had been one of the greatest material factors in the welfare and progress of the human race, he was of the opinion that, considered simply as minerals, they did not even remotely approach in interest a score or more of other mineral substances which he could name without even stopping to think. But if he had to express a decided preference for any particular one of these, it would be carbonate of lime in its multiform varieties. It would be impossible, he said, to find another material which is capable of appealing to our sense of beauty in so many different ways. He then proceeded to explain the intricate molecular structure of calcite and aragonite which manifests itself in the diverse crystal forms and optical properties of these species, then dwelt upon the picturesque and weird forms that Nature has fashioned and carved out of limestone, chalk and coral rock, and on the beauties presented by this substance in the corals, shells and pearls, and in the endless varieties of marble,—white, colored and variegated. And what other material, he exclaimed, can vie with marble in expressing and perpetuating the finest conceptions of the great masters of sculpture and architecture, from the most ancient times to our own day? And if it came to a question of utility, he believed that carbonate of lime exceeded the iron ores even in this respect; for besides supplying us with building stones, concrete and mortar, it was an indispensable adjunct to the manufacture of iron, soda, glass, bleach and innumerable other commodities.

Other speakers then championed with varying success the claims of such minerals as quartz, the felspars, the ores of copper, lead and the precious metals, the diamond and other gems, until another pronounced hit was scored by a mechanical engineer who made an eloquent plea for coal. He regretted that his limited knowledge of geology, botany and organic chemistry would not permit his doing full justice to the subject, but nevertheless he hoped to show that

the fossil remains of an extinct vegetation touched a far wider range of interest than any of the minerals yet mentioned. After giving a fascinating account of the vegetable and mineral history of coal, he explained how the sunshine of a remote geological age had been stored up in this substance, so that it can be conveniently tapped and utilized by man for the production of heat and cold, power, light and electricity, and further how inventive genius and chemical science had united in wresting from the plain black mineral innumerable substances that minister to our wants and comfort. No chapter in the entire realm of science, he contended, could boast of such a wealth of discoveries as the chemistry of coal-tar, itself only one of a number of products resulting from the destructive distillation of coal. There was no room for doubt in his mind that this substance easily takes the first place in the Mineral Kingdom.

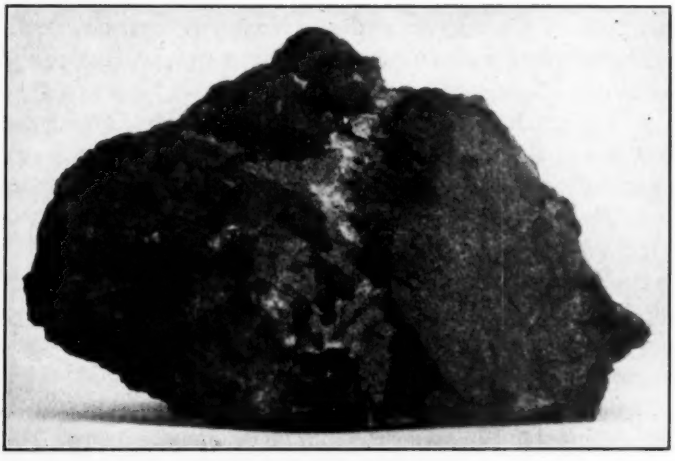
Only one of the company remained to set forth his views on the subject under discussion, and all eyes were now turned upon the plain science teacher at the lower end of the table, wondering what choice was left for him after such a convincing argument in favor of coal.

He rose deliberately, looked at his watch and began with words to this effect: "One of the most coveted trophies of scientific achievement, the Nobel Prize in Chemistry, has just been bestowed upon Ernest Rutherford, whose brilliant researches lie chiefly in the domain of physics. As I interpret the award, however, the Nobel commission intended it as a recognition of the wonderful influence which Rutherford's work has had on chemical investigation, opening up as it did entirely new avenues of research, and stimulating hosts of experimenters to work in the new field. It is significant, however, that the starting point of Rutherford's work was a chemical discovery, the most remarkable of our time; I refer to the discovery of radium in a mineral which for more than a century has engaged the attention of chemists, now proving a will-o'-the-wisp, and again yielding up unexpected finds to the patient investigator. If I may detain you for half an hour longer, I shall endeavor to tell, without going into unnecessary detail, the 'Story of a Piece of Pitchblende.'"

His story was listened to with rapt attention, and while many of the party cast their votes in favor of "coal" and "carbonate of lime," all agreed that at the present time, at least, pitchblende was undoubtedly in the lime-light of scientific interest. And it is my object here to-night, ladies and gentlemen, to introduce this wonderful mineral to your acquaintance.

Here is a typical specimen of pitchblende, and we will have a better view of it by throwing its image upon the screen. You notice that its features are not prepossessing; there is no indication of crystal form, and the complexion is dusky with a resin-like lustre. In this respect the mineral resembles blende, and for this reason was formerly mistaken for an ore of zinc.

Old Werner, the father of mineralogy, believed it to be an iron ore, while others, on account of its high specific gravity, suspected that it contained tungsten.



Pitchblende from Joachimsthal

Our specimen comes from Joachimsthal, a place in Bohemia which has long been famous for its silver mines, and from which the German *thaler* and our dollar derive the names. It is the only locality where pitchblende is actually mined, and the Imperial factory at Joachimsthal is, I believe, the only plant where the mineral is worked up on a large scale.

But pitchblende, or *uraninite* as mineralogists prefer to call it, is found also in many other localities, both in Europe and America. In some cases it forms an original constituent of granite rocks, while in others it occurs in deposits of metallic ores. Considerable quantities of the mineral are met with in certain parts of Saxony and Bohemia, at St. Stephens in Cornwall, in Mitchell County, North Carolina, and in Colorado and South Dakota. Two of the most interesting varieties, *cleveite* and *bröggerite,* come from Norway.

The external characters of uraninite from different localities vary within wider limits than those of other species. In rather rare instances the mineral is crystallized in cubes or octohedra, but usually it is massive or of granular structure. Its color is grayish, greenish-brown, or black; its lustre pitch-like or dull. The specific gravity fluctuates from 6.5 to nearly 10.

Martin Heinrich Klaproth

Now a substance which exhibits such great variations in its physical properties must also be variable in its chemical composition, and pitchblende, as we shall see, is no exception to this rule. The chemical history of the mineral began in 1789, when a German apothecary, Martin Henry Klaproth by name, discovered that its principal constituent was a previously unknown metal to which he

gave the name uranium, after the planet Uranus, then recently discovered by Herschel.

I may mention here in passing that the art of chemical analysis was in those days almost monopolized by your profession, and that many of the most important chemical discoveries of the eighteenth century must be credited to pharmacists.

But neither Klaproth nor his contemporaries who investigated the new metal succeeded in obtaining it in the free or elemental state. This was not accomplished until 1840, when the French chemist Péligot demonstrated that the supposed metal was really an oxide and that its isolation requires special means to remove the oxygen. Thanks to his researches and those of Roscoe, Zimmermann and others, we are now as familiar with this rare element as we are with the more common elementary bodies. Its peculiarities and idiosyncrasies have been duly noted and recorded, and its proper place in the natural families of elements definitely established.

Moissan has taught us how metallic uranium can readily be produced by the reduction of its oxides in the electric furnace. We can also effect its reduction by the Goldschmidt process, that is by the aid of metallic aluminum. I am not aware, however, that metallic uranium has found any practical applications. It is in the form of compounds that uranium is extracted from pitchblende at Joachimsthal, the products being highly prized as pigments in the manufacture of glass and for decorating china. The uranyl compounds are characterized by a fine yellow color and a strong green fluorescence. This piece of uranium glass, for instance, is yellow in transmitted light, but shows a beautiful green color on the surface. Here are a number of uranyl minerals and salts, all of which show this peculiar phenomenon. This black substance is an oxide of uranium employed in china painting.

The chemical processes by which the uranium products are manufactured at Joachimsthal are rather complicated, and it would hardly interest you to know the details. Essentially the treatment consists in calcining a mixture of the roasted and powdered ore and soda, washing the yellowish-brown mass resulting from this operation with hot water, and then extracting it with dilute sulphuric acid. The solution so obtained contains the bulk of the uranium, which is further converted into the desired compounds, such as the yellow uranates of sodium or ammonium, and the black oxide of uranium. The insoluble residue was formerly cast aside as a waste-product,

but it has recently become the source of that most interesting constituent of pitchblende, radium.

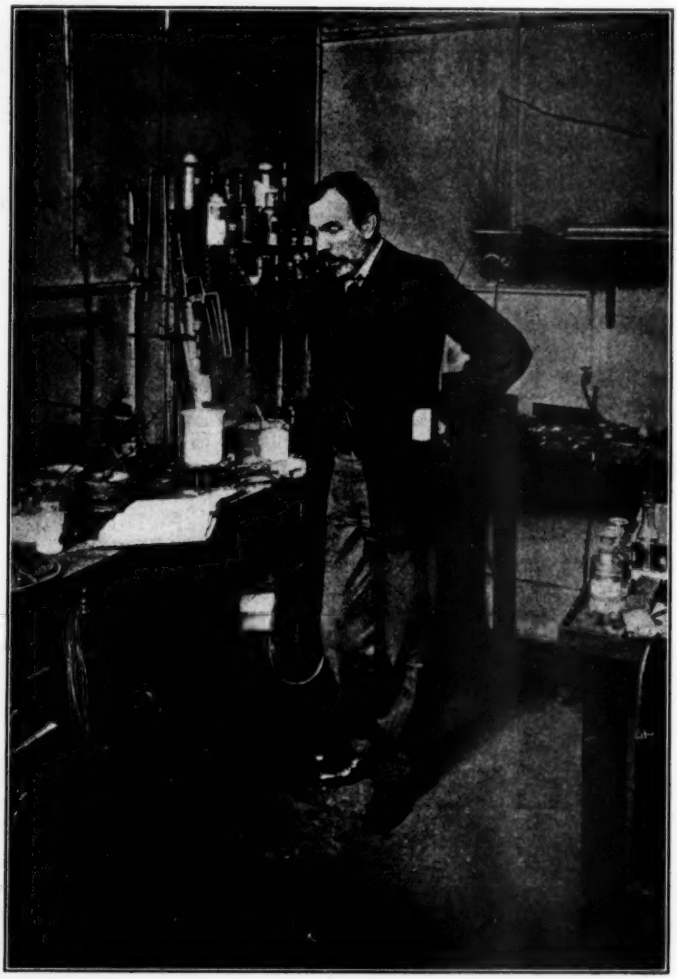
Let us now return to the question of the chemical composition of our mineral. Can it be expressed like that of any well-defined species by a definite formula? I know of no other mineral that has presented so many difficult problems to the analyst, and of none that has so persistently defied his efforts to unravel its innermost nature, as has uraninite. An enormous number of analyses, and many of them by the most skilful chemists, have been recorded, but our knowledge of the constitution of the mineral is far from complete. In one respect, however, all analyses agree: that the principal constituent of pitchblende, say from 50 to 80 per cent. of it, is the uranate of uranyl, or in the shorthand of chemists, Ur_3O_8. In addition to this, varying amounts of many other elements have been found in the different varieties; indeed it would seem as if nearly all of the known elements existed in one or another of the modifications of this mineral. That many of the minor constituents are merely admixtures, that is to say, do not enter into the composition of uraninite, is generally recognized, but the rôle which others play in it is only imperfectly understood.

Invariably present in all varieties are the oxides of lead and iron; the majority contain also alumina, lime and magnesia, and some of the rarer varieties are characterized by considerable proportions of rare earths, such as thoria and yttria.

It is not my intention here, to-night, to discuss the extended literature on this subject, but I can recommend it as affording much interesting and some amusing reading; one writer after another claims to have solved the riddle of the composition, and charges all others with the gravest errors, only to be told in turn that he, too, is entirely mistaken.

It was on account of an unfortunate oversight in the analysis of cleveite that one of the foremost chemical experts of our country just missed the honor of having discovered that most interesting of gaseous elements, helium. This is the way it happened: In 1891 Dr. Hillebrand, chief chemist of the United States Geological Survey, observed that many of the uranium minerals, and notably cleveite, give off considerable quantities of gas when they are heated with acids. He carefully collected this gas and subjected it to various tests, but although he noticed certain peculiarities in its behavior, he concluded that it was nitrogen. Four years later the

great English chemist, Prof. William Ramsay, in searching for compounds of the then newly discovered element argon, had his attention called to the cleveite gas, and made a thorough chemical and spec-



Copyright, 1904, *Scientific American.*
Sir William Ramsay in his laboratory

troscopic examination of it. To his surprise it showed a spectrum entirely different from that of either argon or any other known terrestrial element. The most characteristic of the several bright

lines of this spectrum was, however, soon recognized by Sir Norman Lockyer as the yellow " D3 " line which he and Janssen had observed in the spectrum of the sun's chromosphere during the eclipse of 1868. The brilliant line had been attributed to an element supposed to exist only in the sun and certain stars, and this hypothetical solar constituent had accordingly been named helium (from Helios, the sun). Thus after a lapse of 27 years terrestrial helium was found, and the searching investigations of Prof. Ramsay and of the Swedish chemist Langlet soon established the true character of the new element. Like argon, it was found to be devoid of chemical energy, showing no tendency to form compounds with any of the known elements, and to consist of monatomic molecules. Physically, however, it differed from argon in its lightness—its density is only 2 compared to hydrogen—in its very slight solubility in water, in its behavior at low temperatures, as well as in other ways.

Of all the gases known to chemistry helium is the most perfect. Thermometers filled with it afford the most reliable means of measuring extremely low temperatures, and the liquefaction of this gas, which was only recently effected by Prof. Kamerlingh Onnes of Leyden, is regarded as the crowning triumph of low-temperature research. The picture and diagram upon the screen will give you an idea of the complicated apparatus by which the Dutch physicist attained his object.

The occurrence of helium is by no means confined to the heavenly bodies and cleveite. Minute quantities of it exist in the atmosphere, it is present in the gases dissolved in many mineral waters, like those of Bath and Cauterets, and has been detected in a great number of minerals, particularly those containing the heavy elements uranium and thorium.

In view of the circumstances surrounding the discovery and investigation of helium, you will readily appreciate the prominent part this element has played in the recent history of chemistry; yet its claims upon the attention of scientists were to be vastly enhanced by another discovery for which pitchblende also supplied the material.

This brings us to the most interesting chapter of our story. In 1896 the late and lamented Henri Becquerel, while engaged in the study of the phosphorescence of certain uranium salts, made the remarkable observation that they continuously emit rays of a peculiar character. His experiments showed that these radiations could not

be due to phosphorescence, but were in some way connected with the uranium contained in the salts; for the strange property was exhibited also by the non-fluorescent uranium compounds and metallic uranium, even after these substances had been kept for a long time in the dark. *Uranium rays* was the name proposed by the discoverer for these invisible radiations, but they have since been re-christened *Becquerel rays,* and they are now recognized as a manifestation of that most remarkable condition of matter called radio-activity.

Let us see by what means these Becquerel rays can be detected and measured. The easiest way, perhaps, is that by which Becquerel discovered the phenomenon. It consists in placing the substance under examination, a piece of pitchblende for instance, upon a photographic plate wrapped in black paper. The rays then penetrate the latter and act on the plate, producing an impression analogous to that of ordinary light. It is thus possible to make radiographs of objects which are not transparent to the Becquerel rays.

Another method of testing for radio-activity is to allow the substance to act on certain crystalline substances, such as barium platinocyanide or the sulphide of zinc, known as Sidot's blende. If the radiations are fairly strong, they are made manifest by the gleam or the scintillations they excite in the phosphorescent material.

More delicate and far better adapted for the measurement of radio-activity, is the electric method. This depends on the fact that the rays emitted by radio-active substances have the power to ionize the air through which they pass, and of thus conferring upon this air the property of discharging electrified bodies. The rate of discharge is proportional to the intensity of the radio-activity. The instrument commonly used for this purpose is the gold-leaf electroscope, for the fall of the gold leaf can easily be observed and measured.

It was by the aid of this electric method that one of the most successful investigators of our time, Mme. Sklodowska Curie, undertook, in 1898, to make a systematic examination of a great number of substances, including both elements and compounds, for radio-activity. She discovered that thorium is radio-active in about the same degree as uranium, and that some of the uranium and thorium minerals are several times as radio-active as the two metals are in the free state. Further inquiries showed that the radio-activity of uranium is not affected by the combination of the element with other elements, so that it must be regarded as an atomic property. The only way then that the excess of radio-activity of the uranium

minerals could be accounted for, was to assume that they contained some unknown substance of extraordinary radio-active power.

But how could this hidden constituent be brought to light? Chemists had apparently exhausted their analytical resources in the study of pitchblende, the mineral which headed Mme. Curie's list of radio-active substances. Her fertile mind, however, devised a novel means of searching for the hypothetical component: by introducing the electroscope into chemical analysis, and systematically testing the

Copyrighted, 1904, by William J. Hammer.

Mme. Sklodowska Curie

products of chemical separation for their radio-active power, she succeeded in concentrating those intensely radio-active substances in certain minute fractions of material she obtained from the ore.

It was evident now that the extraction, even of small quantities of the radio-active body or bodies, would require the use of enormous quantities of the costly pitchblende; but this difficulty was overcome by the happy idea to experiment upon the uranium residues of which such large quantities had accumulated at Joachimsthal. Mme. Curie and her husband, the late Pierre Curie, having ascertained that this material contains practically all of the radio-active components of

the pitchblende, asked and obtained permission from the Austrian Government to draw upon these residues, and a ton or more of the material was shipped to Paris and there treated under the able direction of M. Debierne. From the crude products thus obtained the Curies extracted two distinct substances of most remarkable radio-active power.

The first of these, which was separated with the bismuth and which closely resembles the latter chemically, was named *polonium,*

Copyrighted, 1904, by William J. Hammer.

Pierre Curie

in honor of Mme. Curie's native country, Poland. Although it has since been obtained and studied by other scientists, it has not been prepared in the pure state, indeed it is still doubtful whether it constitutes a chemical element.

Far more important is the second radio-active substance of which the discovery was shortly afterwards announced by the Curies and M. Bémont. It has appropriately received the name *radium,* being fully two million times as active as uranium, and it has been clearly characterized as a new element. It must be admitted that, owing to the extremely precious nature of the radium compounds, little at-

tempt has been made to reduce radium to the elemental state; there can be no doubt, however, that it would be found to be a metal similar to barium, which it closely resembles in its compounds. The chemical reactions and the spectrum of radium are analogous to those of the alkaline-earth metals, and its atomic weight of about 226 fixes its position as the fourth member of this family in the periodic system of Mendelejeff. Small amounts of radium salts have been prepared in the pure state by the Curies, by the German chemist Giesel, and quite recently by the Austrian Radium Commission. In appearance and reactions they differ very little from the corresponding barium salts, but are readily distinguished from the latter by their radio-activity. With the most approved processes less than fifty grains of radium bromide have been obtained from ten tons of uranium residues, and the entire stock of pure radium preparations now in the hands of investigators probably falls short of 100 grains. You can readily appreciate the exceedingly precious character of this material.

In addition to polonium and radium a number of other radio-active bodies have been separated from various uranium and thorium minerals. They differ from radium both in their chemical character and in their radio-active properties, but for the most part appear to trace their origin to the same parent substance. The most interesting among them are *actinium,* which Debierne has separated from the thorium contents of pitchblende, and *ionium,* recently discovered by the American chemist Boltwood, as a constituent of carnotite, a vanadate of uranium found in Colorado.

The discovery of the radio-active substances, and especially of radium, has had a wonderfully stimulating influence on research in physical science, and the advances that have been made in this field during the past decade have been so rapid that it would lead us far beyond the scope of this lecture to consider even in a general way our present knowledge of the subject. I must content myself with bringing to your attention a few facts that will help you understand the rôle which the radio-active substances play in pitchblende.

It has been ascertained that the rays emitted by these substances are of three distinct types, differing from one another in their power of penetrating matter and in their behavior towards the magnetic or electric field. They are respectively known as alpha, beta, and gamma rays. The alpha rays are completely stopped by a layer of

aluminum no thicker than 1/500 of an inch, and are but very slightly deflected out of their course by a magnet. They are believed to consist of material particles of a density about twice as great as that of the hydrogen atom, and to be projected at a speed of some 20,000 miles per second. The beta rays travel with a much greater velocity, and are strongly deflected by a magnetic field. They are regarded as particles of only 1/1000 the weight of the hydrogen atom, and charged with negative electricity. The gamma rays are 10,000 times as penetrating as the alpha rays and are not deflected by the magnetic or electric field. They invariably accompany the beta rays, and appear to be a wave motion set up in the ether by the expulsion of the beta particles. The three types of rays can thus be separated and distinguished from one another by means of the magnetic field, as well as by their different penetrating powers.

For our knowledge of these radiations we are chiefly indebted to the work of Ernest Rutherford, a native of New Zealand, and now Professor of Physics in Victoria University, Manchester, England. The picture on the screen shows the brilliant investigator in his laboratory at McGill University of Montreal, where most of this work was done.

But more remarkable even than these investigations are some other contributions which Rutherford has made to our knowledge of the radio-active substances; indeed his experimental discoveries and his theoretical reasoning have thrown such a flood of light upon the subject that it may fairly be claimed to be one of the most assiduously cultivated and most productive fields of scientific research at the present time.

Perhaps the most striking discovery in radio-activity next to that of radium, is the observation that some of the radio-active substances continuously give off gases which have properties of the most extraordinary character. These gases differ from all other gases with which we are acquainted in that they rapidly decompose or disintegrate, and in being powerfully radio-active. This was first noticed by Rutherford in the case of thorium, and subsequently it was found that radium, actinium and, perhaps, other bodies of this class give off similar *emanations.*

The several emanations differ from one another in their "periods of life," that from radium being the slowest to decay and therefore the one which has been best investigated. "The strongest and strangest thing in the world," are the words in which Sir William

Ramsay has aptly summed up its character; for it differs in many respects from all other forms of matter, and is capable of producing most wonderful effects on other bodies.

Unlike the radiations, the emanation is scarcely given off by radium compounds in dry air, but is released from them when they are heated or dissolved in water. In the latter case the water is decomposed in a similar way as by an electric current, yielding up bubbles of gas. This gas is a mixture of oxygen and hydrogen, very nearly in the proportions in which these elements exist in water, but it contains in addition a minute amount of the emanation. When the gas is placed in a tube surrounded by liquid air and thus cooled to say 356° F., the emanation condenses or freezes to the walls of the tube, while the other gases can be removed by means of an air-pump. Upon raising the temperature of the tube, the emanation turns into gas again, but its volume is so small that it must be collected in a vessel of exceedingly fine bore. Ramsay estimates that one grain of radium bromide yields about one thirty thousandth cubic centimetre of this gas per week.

You will see from this what enormous difficulties must have been encountered in experimenting with the radium emanation; yet the results which have already been obtained are quite sufficient fully to repay the investigators for their great sacrifices of labor, time and expense.

There cannot be the slightest doubt that the emanation is a gaseous substance. Not only has it been collected and measured, but it has also been shown to obey the simple laws that govern the effects of pressure and temperature upon gases. Moreover, it freely diffuses through other gases, such as air, and, as already stated, condenses to a liquid or solid at very low temperatures. The emanation glows in the dark; its spectrum shows characteristic bright lines, recalling the spectra of the argon group of inert gases. Its density is estimated to be about 100 times that of hydrogen.

Like argon and its congeners, the emanation is not acted upon by the most powerful of chemical agencies. It appears to be chemically inert, and probably belongs to the argon group of elements. But, although devoid of such chemical affinities as are manifested in the chemical changes with which we are familiar, it nevertheless produces most remarkable chemical effects upon other substances. This is due to its enormous radio-active power. Weight for weight it is estimated that the radium gas is 100,000

as active as radium, and the heat liberated in its disintegration, according to Ramsay, is about 3,000,000 times as great as that resulting from the explosion of a like volume of oxyhydrogen gas.

The only product of the disintegration of radium emanation which has been definitely identified is helium, the gas which exists in so many of the uranium and thorium minerals. The production of helium from radium was first observed by Ramsay and Soddy in 1903 and has since been abundantly confirmed by others. It is the first instance of the transformation of one well-defined element into another. The announcement created a sensation in the scientific world, for it broke down one of the most cherished doctrines of chemistry, that of the immutability of the atoms, and thus seemed to shake the very foundations of the atomic theory.

During the past five years there has been accumulated a vast amount of experimental evidence to elucidate the true nature of the radio-active changes, and it is to Professor Rutherford that we owe not only a masterful and complete account of what has been accomplished, but also the one consistent generalization that explains the facts. As my time is nearly up, I must pass over the experimental results from which the theory derives its support, and I shall only briefly indicate the main features of Rutherford's hypothesis. It proceeds from the bold and novel assumption that the atoms of the radio-active elements are in a state of continuous disintegration, and that these smallest units which enter into chemical changes, in the accepted sense of this term, are really made up of great numbers of still smaller particles, carrying negative electrical charges. Just how these electrons, as they are called, are disposed within the chemical atoms has taxed and is still taxing the ingenuity of the foremost physicists of our time, but a fairly satisfactory conception has been developed by such men as Lord Kelvin, J. J. Thomson, Lorentz, and others. According to the electronic hypothesis the integral parts of the complex little structures or atoms are in a state of incessant and rapid motion; they rotate about a common centre, and it is this oscillation which supplies the energy which the atoms are capable of yielding up. The atom as whole is supposed to be positively charged, while the moving electrons carry negative charges. A definite number of the radio-active atoms undergo spontaneous disintegration in a unit of time, one or several of the electrons being expelled, while the remaining ones form a new configuration, which in turn suffers analogous radio-active changes. In

this manner the heavy radio-active atoms are gradually "degraded" into other atoms of smaller weight, but of greater stability. The rays, then, which are peculiar to the radio-active substances, are simply the emission of particles resulting from the continuous disruption of their atoms.

In the light of our present knowledge it appears that the known radio-active substances, with the exception of thorium, are derived from uranium, and represent successive stages in a series of transformations, and perhaps ramifications of this series. These relations are shown in this pedigree: uranium, uranium X, ionium, radium, radium emanation, radium A, B, C,[3] D, E1, E2, and F, which latter is identical with polonium or radio-tellurium. Actinium is regarded as belonging to a branch of this series, while other radio-active substances are the descendants of thorium. There can be no doubt that even the youngest known members of these series undergo further transformations, and not a little evidence has been gathered to indicate that other elements also undergo a "rayless" disintegration into elements of smaller atomic weight. At present, however, the connections which may exist among the non-radio-active elements are largely conjectural, and the observations of some of the most distinguished workers in this field are in many respects contradictory.

This much, however, is certain, that the radio-active changes are not chemical changes in the accepted sense of the term. They must be regarded as a spontaneous disintegration of elementary atoms, and cannot, therefore, be recognized by strictly chemical methods. Their discovery has given us a new chemistry which does not limit the changes in matter to rearrangements of the Daltonian atoms, but penetrates to the still smaller units, or corpuscles, of which they are made up, and to those marvellous forces which are liberated in their disintegration.

In conclusion let us cast another glance at our black and shapeless piece of pitchblende, and recall the interesting and dramatic part this mineral has played in the history of physical science. Its chemical investigation during the past 120 years has not only brought to light a large number of the most interesting elementary substances, but has also furnished science with a novel and most powerful weapon for attacking such fundamental problems as those of the constitution

[3] Radium A, B and C constitute the quickly decaying "active deposit" which radium produces on bodies placed near it.

of matter and the genesis of the elements. And as every advance of knowledge brings with it new problems to be solved, we may confidently look for rich harvests of discovery in the further study of our mineral and its constituents. To him who is gifted with a vivid imagination and disposed to indulge in extravagant speculation, the future history of pitchblende offers an unlimited opportunity to exercise these gifts to his heart's content. He might tell us how some day our mineral will turn out to be a veritable philosophers' stone by which the base metals are transmuted into the precious, and the heavy elements degraded into the lightest of gases; he might enlighten us how, after our coal deposits have been mined and burned up, it will afford almost inexhaustible supplies of energy; and, perhaps, he might even be able to persuade you, gentlemen of the pharmaceutical profession, that it is destined to be the great panacea to cure all ills that human flesh is heir to.

But such visions of the future we may leave to the Jules Vernes and the contributors of our popular magazines. Science is a stern mistress: she clips the wings of phantasy too closely to permit her votaries to deviate—or had I better say aviate?—from the secure tracks of observation and logical induction. If I conclude, then without having satisfied you as to how pitchblende or products obtained from it will some day take the place of your materia medica, I trust that my story has not been unworthy of the kind attention you have given me.

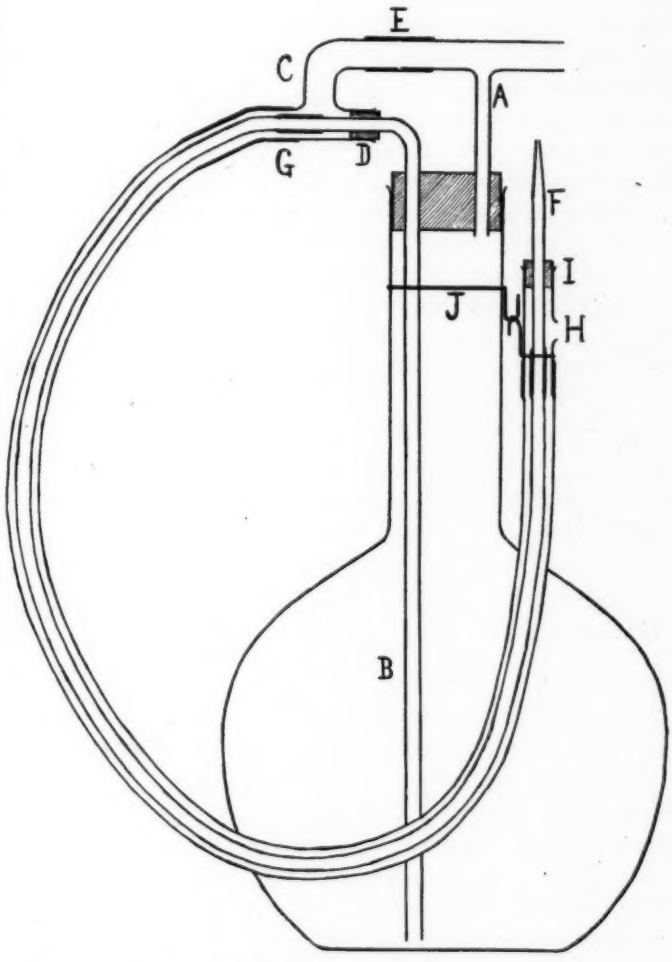
A COMPRESSED AIR WASH-BOTTLE.

By Edwin Dowzard.

In laboratories where a supply of compressed air is available, the apparatus about to be described will be found of value.

The apparatus consists of a flask of suitable size (as the latter is stationary when in use, a flask of two or three litres capacity may be used), provided with a rubber stopper with two perforations. Through one of the perforations a limb of the T piece *A* passes, the horizontal portion of which should be about twice the diameter of the vertical. Through the other perforation passes a tube, *B*, which nearly touches the bottom of the flask. The part outside the flask passes through the horizontal limb of the T piece *C*, and is held in position by the perforated rubber stopper, *D*. The vertical limb

of the T piece *C*, is connected with *A* by means of a piece of rubber tubing, *E*. To the end of the tube *B*, which passes through the T piece *C*, is attached any desired length of narrow rubber tubing; two



Compressed air wash-bottle

feet is a convenient length, although any length may be used. A glass jet, *F*, is attached to the end of the tubing. A piece of rubber tubing about twice the diameter of the narrow tubing is passed over the latter and attached to the T piece *C*, at *G*. The other end is

attached to a piece of glass tubing, *H*, in the side of which a hole about 6 mm. in diameter has been blown. The jet, *F*, is fixed firmly in this tube by means of the perforated rubber stopper *I*. A piece of copper wire provided with a hook is attached to the tube *H*, so that the latter may be suspended from the wire *J*, which is attached to the flask. The end of the T piece *A*, is connected with the compressed air main by means of rubber tubing. When the compressed air is turned on, it passes through the horizontal portion of T piece *A*, then through T piece *C*, and leaves the apparatus at the hole *H*. When the apparatus is in use the thumb of the right hand is placed over *H*, the compressed air then passes through the vertical limb of T piece *A*, into the flask, and forces the water through the jet *F*.

Very little compressed air is required by this apparatus. If the air is turned on in the morning, the apparatus may be used at any time by simply placing the thumb over *H*. The force of the jet may be easily regulated by allowing part of the air to escape at *H*.

This apparatus is very convenient for washing precipitates, etc., as the jet of water may be sent in any direction by a slight turn of the wrist.

Analytical Department,
Parke, Davis & Co., Detroit.

A NOTE ON THE PERIODIDE TEST FOR ALKALOIDS.

By A. H. Clark.

In the course of the alkaloidal assay of crude drugs one is constantly testing for the presence of alkaloids to determine whether or not extractions are complete. Of the numerous tests employed, a solution of iodine in potassium iodide and water is very common because of its great sensitiveness, simplicity of preparation, and ever readiness. This solution, as is well known, when added to an acidulated solution of an alkaloid yields a brownish-red precipitate.

On one occasion when extracting an ethereal solution of an alkaloid with normal acid I attempted to use this test to determine when all of the alkaloid was extracted from the ether. After shaking out with eight or ten portions of acid and still obtaining a precipitate indicating incomplete extraction, I concluded that something was wrong and began a search for the trouble. This search (the details of which I will omit) revealed the, to me, surprising fact that water saturated with ether and then acidulated gives with iodine

solution a reddish-brown precipitate of iodine, which, in appearance, resembles the precipitate formed when the iodine solution is added to a solution of an alkaloid.

A saturated solution of ether alone will not precipitate in this manner, neither will acid, or water and acid together. The addition of an equal volume of water at once dissolves the precipitate.

The necessity of guarding against this condition will be apparent to all those interested in alkaloidal work. If this test is used where ether is the solvent the acidulated solution should be diluted with water before applying the test. It is still better to add the iodine first, and if a precipitate is obtained add water, when it will disappear if caused by the ether.

University of Illinois School of Pharmacy.

THE ENZYMES OF COW'S MILK.

By Joseph W. England.

Milk is not simply a mixture of chemical compounds. It is an organized tissue, as much so as blood. In fact, the resemblance is so close that it could be called "white blood." It contains not only fat, proteids, sugar, salts, and water, but also the elements that go to make up blood. Among these may be mentioned the enzymes or ferments. The presence of these bodies has been known for a decade or more, but their physiological significance, in the growth and development of the tissues of the body, has been, apparently, entirely overlooked.

The function of food is not only nutritional, but also developmental; that is, it furnishes not only pabulum for the tissues, but stimulates the growth and development of the digestive tract, especially in infants and growing children. Milk, and probably other foods also, furnish enzymes that promote, in some degree at least, the development of the digestive tract. The reason why *unboiled* milk is superior to *boiled* milk, as an infant food, is because it contains enzymes or ferments that assist digestion; in other words, it is autodigestive, while in boiled milk, the enzymes have been destroyed, and its autodigestibility lost.

The power of ferments for work is remarkable. As Abderhalden states (*Physiological Chemistry,* 1908, 46): "They are never found as end products of the reactions. They remain unchanged. The smallest amount suffices to repeat the same reaction a countless

number of times. Thus, invertase is capable of inverting at least 200,000 times its own weight of cane sugar (*Jour. Chem. Soc. Trans.*, 57, 384, 1890), and rennin at least 400,000 parts of casein. The action of the ferments should be, theoretically, an unlimited one. There is, however, as has been shown in the case of rennin (Reichel and Spiro: Hofmeister's Beitrage 6, 68, 1904, and 7, 479, 1905) a gradual loss of efficiency. This is not, however, caused by the reaction of itself, but by other factors.

Now, as to the specific ferments of milks: The most important of these is *galactase,* a proteolytic enzyme of the tryptic group, discovered by Babcock and Russell in 1897. These investigators observed that milk kept under certain antiseptic conditions showed, in time, a progressive increase in the percentage of "nitrogen compounds soluble in water," which were formed at the expense of the casein.

"In milk 12 days old ('The Soluble Ferments,' by J. Reynolds Green, 1901, 207), the nitrogen existing in this condition was 30 per cent. of the total nitrogen; in one 240 days old, it had become 63 per cent. In another sample, twelve hours after milking, it was less than 10 per cent., but after three weeks' standing it had risen to 30 per cent. During all this time bacteria were found to be entirely absent. These changes in milk did not take place in samples that had been boiled at the outset."

These experiments clearly demonstrated the presence of a proteolytic ferment in fresh milk. The ferment was isolated by centrifuging the milk, collecting the slime that remained adhering to the instrument, mixing it with an equal weight of 40 per cent. alcohol, and adding an antiseptic. After standing twenty-four hours, the mixture was filtered, the filtrate concentrated by evaporation at 52° C. to one-tenth its original volume, additional antiseptic being added. The faintly acid solution was then neutralized with sodium carbonate, when syntonin and calcium phosphate were precipitated. The filtrate from this precipitate curdled milk, and subsequently dissolved the curd, indicating the presence of rennet and a proteolytic ferment.

While galactase belongs to the tryptic group, it differs from trypsin in forming not only amido-acids, and albumoses and peptones, but later, also, a certain quantity of ammonia.

The principal properties of galactase are:

(1) It hydrolyzes proteids, especially casein, carrying the decomposition to the liberation of ammonia.

(2) It is active in neutral, faintly alkaline and faintly acid solution; a very slight excess of acid rapidly inhibits its action.

(3) Its optimum point is 37°–42° C., its activity at 52° C. is about equal to that it exhibits at 28° C.; its proteolytic power is destroyed at 76° C., and its action on gelatin—which it liquefies—takes place at 65° C.

(4) It decomposes hydrogen dioxide with the liberation of oxygen, being probably one of the ferments which react with the Wilkinson–Peters test or the Dupouy test, observed by Charles H. LaWall, and reported to the pharmaceutical meeting of the Philadelphia College of Pharmacy in January, 1909 ("The Differentiation of the Enzymes of Milk by Hydrogen Dioxide and its Tests," by Charles H. LaWall, AMERICAN JOURNAL OF PHARMACY, February, 1909, 5).

(5) It is inhibited in action by mercuric chloride, formaldehyde, carbon disulphide and phenol, but not by chloroform, ether, benzol, or toluol.

Later, without knowledge of the work of Babcock and Russell, Bertrand and Bourquelot demonstrated, by other methods, the presence of an oxidizing ferment in milk. "As long ago as 1881," states the *Dietetic and Hygienic Gazette* (1904, 523), "Arnold had found that fresh cow's milk became blue on contact with tincture of guaiac, and that this reaction is no longer produced if the milk be heated to a temperature of 80° C. In 1890 Kowalesky established undeniably that the same reaction takes place in milk when mixed with old oil of turpentine. But at that time this reaction was attributed to the presence of ozone. Later it was recognized that free ozone cannot exist in the system, and Bertrand and Bourquelot demonstrated that the reaction of milk toward oxidizing agents is due to the presence of a ferment (an *oxydase*). Of itself it is powerless to oxidize oxidizable substances without the assistance of an intermediary agent highly oxygenated, such as the tincture of guaiacum, old turpentine or oxygenated water. But, when these agents yield their oxygen to this ferment, the latter is able to hold it, and in consequence to oxidize any oxidizable substance with which it comes in contact. For example, if some drops of tincture of guaiac are added to fresh milk, this does not change color. But if at the same time some drops of oxygenated water are poured into the milk, a blue color begins to show itself at once. The ferment has absorbed a portion of the oxygen, and coming into contact with the guaiac has oxidized the latter. Thus this ferment belongs to

the family of anaëroxydases. At this same time Dupouy, and in the following year (1898) W. Raudnitz, studied this oxydase, and found that it is present in the milk of the goat, the cow, and the ewe, and that it is absent, or that its action is very weak in the milk of the ass, the mare, the dog, and in human milk. Marfan and Fillet have also studied this ferment, and confirm its presence in the milk of the cow.

"In 1901 Spolverini took up this line of research and recognized in cow's milk the presence of *pepsin* and *trypsin*. Working on milk aseptically treated, and in which perfect asepsis was maintained by thymol, he placed in a drying-stove, at 104° F., various quantities of milk, some acidified for the research for pepsin, others alkalinized for the research for trypsin. After a certain time, he determined the quantity of soluble albumins in it by the biuret reaction. A boiled sample served as a means of verification. By proceeding in this manner, Spolverini found that the pepsin and trypsin were to be met with in all the milks, but were most abundant in cow's milk. The proportion diminishes in the milk of the dog, the goat, human milk, and that of the ass. Besides these ferments, of which we have already spoken, still another is to be found, which Spolverini identifies with the *glycolytic* ferment of the blood. If the sugar contained in a given quantity of fresh milk is determined, and the latter is placed in a drying-stove at a temperature of from 38° to 41° C., and the quantity of sugar is again determined after a lapse of twenty-four hours, it will be found that the quantity of sugar has considerably diminished. A portion has been destroyed. This is by the action of a glycolytic ferment. This ferment shows itself fairly active in cow's milk, but slightly less so in other milks. Moreover, in 1901, Luzzati, Boilchini, and Marfan, and in 1902, Gillet, as well as Spolverini, separated still another ferment that belongs to the family of hydrolytic ferments. Under the influence of this ferment, monobutyrin resolves itself into butyric acid and glycerin. These authors operated by distilling a mixture of milk and monobutyrin, and in then determining the acidity of the distilled products. They encountered this reaction of splitting up monobutyrin in the milks of woman, dog, cow, goat, and ass, stronger in the former, and less energetic in the latter. They have agreed upon giving this ferment the name of *lipase*, a name which Bourquelot had given to a ferment of the same nature, which Hanriot was the first to discover in the blood."

By these findings it will be seen that cow's milk contains numerous ferments, and these have been found, also, in the milk of a number of mammifers, such as the ass, mare, goat, sheep, sow, buffalo and woman.

The ferments found in cow's milk are curdling, proteolytic or proteid-digesting, amylolytic or carbohydrate-digesting, and hydrolytic or fat-splitting. The quantities of the ferments present are small, but when we consider that they are catalyzers, and exert their power over and over again, after the end products have been removed from them, that they are probably the source from which the growing body gets its natural supply of ferments, and that they accumulate within the body, the physiological significance of their presence in milk becomes apparent.

ALPHA- AND BETA-IONONES.[1]

By Samuel P. Sadtler.

The artificial manufacture of both flavoring and odoriferous natural principles has long been a problem which has enlisted the skill of some of the ablest of organic chemists. A notable achievement in this line was the production of artificial vanillin in 1874, by Professor Tiemann of the University of Berlin, from the coniferin of the pine cones. This new and widely noticed synthetic product was shown in the German Chemical Exhibit at the Centennial Exposition in this city in 1876, and I was so fortunate as to get a small vial of this exhibit at the time, which I still have as an interesting historical specimen.

The same Professor Tiemann, who had in the meantime successfully launched vanillin in a commercial way, then undertook to study the nature of the odoriferous principle of the orris root and the violet. After an extensive investigation he succeeded in isolating the odoriferous principle "irone," $C_{13}H_{20}O$. As thus extracted it was very costly and the amount was small. He then undertook the preparation of a synthetic compound of the same formula as irone, hoping thus to get a similar odoriferous principle. By the condensation of citral, $C_{10}H_{16}O$, with acetone, C_3H_6O, he obtained a compound

[1] Read before the Philadelphia Branch of the American Pharmaceutical Association, March 2, 1909.

$C_{13}H_{20}O$. This compound, an open chain ketone, was not the same as irone and had an odor only slightly recalling that of violet. It was moreover unstable and decomposable by alkalies. But he found that by the action of dilute acids he could convert it into an isomeric ketone, cyclic in structure, which had in the fullest degree the violet odor, and in very diluted form served as the basis for artificial violet perfumes. The ketone first obtained was called "pseudo-ionone" and the second product "ionone."

His earliest patents for this ionone were taken out in 1893 and U. S. Patent 556943 of March 24, 1896, speaks of this product as a "fragrant ketone of the formula $C_{13}H_{20}O$."

In 1897, however, apparently independently, Chuit, Naef & Co., of Geneva, called attention to a violet essence, or ionone, of slightly different properties, and Tiemann soon announced (*Berichte*, 1898, p. 867) that there existed two isomeric and physically different ionones, viz., α-ionone and β-ionone, and that one or the other predominated according as the conversion of the pseudo-ionone was effected by dilute acids (the method of his 1893 patent) or by concentrated acid in the cold. In the 1898 *Berichte* article Tiemann gives the credit of the latter discovery to his French business associate, Edgar DeLaire, and it was DeLaire who applied for the U. S. patent November 3, 1897, and to whom it was issued March 5, 1898. It is claimed, however, that a product consisting predominately of β-ionone (and DeLaire's product always contains some α-ionone) was marketed by Chuit, Naef & Co. in the early part of 1897, and a process substantially that of Tiemann and DeLaire had been described by Barbier and Bouveault in the *Bulletin de la Societe Chimique* in 1896.

Be that as it may, we now have the means of preparing an artificial violet characterized by the predominance of either α- or β-ionone and as there is a slight but appreciable difference in the violet perfumes made from these two, both are manufactured.

The most important physical and chemical distinctions between the two ionones may thus be stated:

	α-ionone	β-ionone
Specific gravity at 20° C.	0.930	0.944
Boiling point at 11 mm. pressure	123°–124° C.	(10 mm.) 127°–128° C.
Boiling point at 17 mm. pressure	134°–136° C.	(18 mm.) 140° C.
Refractometer N_D	1.498	1.521
Oxime melts at	89°–90° C.	oily
Semicarbazone melts at	107°–108° C.	148° C.
ρ-bromphenylhydrazone melts at	142°–145° C.	115°–116° C.

From this comparison of physical properties of the two ionones and their compounds it will be seen that a perfect separation of the two when occurring in admixture is not an easy task.

Fractional crystallization of the mixed semicarbazones and *p*-bromphenylhydrazones has been used and differences of solubility of the same, but the methods that are most satisfactory are both upon the different behavior of the bisulphite compounds of the two ionones. The firm of Haarmann & Reimer, the holders of the Tiemann and DeLaire patent in Germany, published the first of these methods, which is to boil the mixture of α- and β-ionones with a concentrated aqueous alkaline bisulphite solution until they both go into solution. On distilling the solution with steam, β-ionone is set free from its combination and can be distilled over, while α-ionone is only set free after making the solution alkaline with sodium hydroxide.

The other process is that of Chuit, Naef & Co., and depends upon the saturation of the mixed bisulphite solutions of the two ionones with salt, when the α-ionone compound separates out insoluble in the salt solution while the β-compound remains dissolved. Both hydrosulphonates may then be decomposed with alkalies and the respective ionones set free.

The difference in odor between the pure α- and β-ionones is sufficient to enable a person with some little practice not to mistake one for the other; when the oils themselves are smelled, the α-ionone is possessed of a sweeter and at the same time more penetrating odor, reminding one more of the orris than the β-ionone, but if a drop of each of these products is allowed to evaporate spontaneously on a slip of paper, it is noticed that the β-ionone yields a perfume which is quite as strong and which has perhaps more resemblance to the true odor of the flower.

Both the product of the Tiemann patent No. 556943 and the DeLaire patent No. 600429 are mixtures, although in the former the α-ionone predominates, and in the latter the β-ionone is the chief ingredient. As these mixtures differ from each other in odor, and both differ from the pure ionones separated by one of the methods mentioned above, it is obvious that the perfumer has a variety of slightly different violet perfumes, made possible by varying his choice of the basic substance used.

Violet extract, or violet perfume, as sold, however, always contains other essential oil extracts, as "adjuncts" or "auxiliaries" to

the underlying odoriferous substance. " Intermediaries " or " blending agents " are also used and the true final perfume effect often only develops after the mixtures have stood for a few days.

There is no doubt, however, that the ionone synthesis of Tiemann has been the most marked advance made in the perfume field that we have as yet recorded, and it illustrates well what organic research is capable of doing for an important industry.

FEDERAL CONTROL OF THE MANUFACTURE OF THERAPEUTIC SERA.[1]

By John F. Anderson,
Assistant Director Hygienic Laboratory.

I wish to speak especially of the practical working of the federal control of the manufacture of therapeutic sera as exercised by the Public Health and Marine-Hospital Service through the Hygienic Laboratory.

On April 1, 1905, the standard unit for determining the strength of diphtheria antitoxin in the United States was promulgated; it was approved and included in the Eighth Decennial Revision of the Pharmacopœia.

The American standard unit for tetanus antitoxin was promulgated October 25, 1907. Before the diphtheria unit was adopted most of the manufacturers in this country used the Ehrlich unit, which is of the same value as the American unit for the standardization of diphtheria antitoxin; before the adoption of the standard tetanus unit by the Public Health and Marine-Hospital Service there were as many different units for measuring the strength of tetanus antitoxin as there were producers.

You may be interested to know how this control is exercised by the Public Health and Marine-Hospital Service over the production of therapeutic sera. In accordance with an Act of Congress approved July 1, 1902, and the regulations framed thereunder, all persons or establishments engaged in the manufacture and interstate sale of viruses, serums, toxins, and analogous products are required to be licensed by the Secretary of the Treasury upon the recom-

[1] Read before the Washington Branch of the American Pharmaceutical Association, February, 1909.

mendation of the Surgeon-General, after a sanitary inspection has been made of their establishments, methods, and products.

An inspector visits the establishment and examines carefully the sanitary condition of the buildings, the condition of the animals used for the production of the serum, the technic—such as methods of bleeding, collecting and storing the serum, and especially the methods used in measuring the strength of their product. He sees as to the labelling of the product, paying especial attention to the date when the serum is labelled to be exchanged. He also takes samples of their various products, which are forwarded to the Hygienic Laboratory for examination.

Upon the results of the examination of these samples and his inspection of the establishments are based his recommendation for or against a license for the particular establishment.

After a firm has been licensed to engage in the manufacture and interstate sale of these products, samples of their products are bought at frequent intervals in various parts of the country and examined in the laboratory. These samples are examined, first, as to labelling; second, as to the potency of the product; third, as to sterility and the presence of toxins; fourth, as to the amount of preservative.

If the samples are found to be deficient in any of the above particulars, the matter is at once reported to the Surgeon-General who, in the case of a lack of potency, contamination, or excessive amount of preservative, requires the manufacturer to withdraw from the market that particular lot of serum. This is a comparatively easy matter for them to do, as they are required to label each lot of serum with a laboratory number and keep records to whom the same is sold.

Since April 1, 1905, many samples of serum have been examined in the Hygienic Laboratory, and of this number only a very few have been found to be below strength or contain a less number of units than labelled, or to have bacterial contamination.

The great advantage of this strict control over these products to the physician, and consequently in the control of the various diseases for which they are used, is of course very manifest.

There is at present no control over the sera for veterinary use. We have recently examined in the laboratory some veterinary tetanus antitoxins and found them to contain less than 25 units per cubic centimetre, whereas the minimum strength of any tetanus

antitoxin for human use is found to be more than 160 units per cubic centimetre.

Now the physician, when he buys a package of diphtheria or tetanus antitoxin labelled to contain 1000 or 2000 units, as the case may be, can be absolutely sure that his patient will get at least that number of units.

Another result of the control over the manufacture of these sera has been a progressive increase in the potency of the sera now marketed and as marketed four or five years ago. I should say that now the average strength of the diphtheria antitoxin placed upon the market is over 600 units, whereas four or five years ago the average strength was about 300 units; and this has been done without an increase in cost of the sera to the consumer.

In conclusion I would say that the tests for potency, freedom from bacterial and toxin contamination, and the amount of preservative, are necessarily performed upon certain small animals. Without the use of physiological tests for the determination of these points there would be no way in which we could arrive at any conclusion as to the strength of the various sera and their freedom from certain toxins, especially those made by the tetanus bacillus.

EXISTING LAWS REGULATING THE SALE OF HABIT-FORMING DRUGS AND THE NECESSITY FOR ADDITIONAL LEGISLATION.[1]

By L. F. Kebler,
Chief, Division of Drugs, Bureau of Chemistry, Department of Agriculture.

The fact that certain drugs tend to produce pernicious habits when improperly used, or used without due circumspection, has been known since the memory of man, but it is only within the last few decades that any material legislation has been enacted in this country tending to limit their indiscriminate sale. Habit-forming drugs are poisonous. The prime object for enacting laws governing the sale of poisons, etc., and restricting their sale to druggists, etc., is to inform the public that these agents are not only dangerous to life but should be used with the utmost precaution. The main object

[1] Read at the second regular meeting of the Washington Branch of the A. Ph. A., Jan. 12, 1909.

of this communication is to consider legislation dealing specifically with the sale of habit-forming drugs, and therefore laws dealing with other features will be considered only incidentally.

The earliest law at present in force in the United States (to the writer's knowledge) restricting the sale of opium was passed in 1885 in the state of Oregon, and the same law is also effective in Alaska. In 1887 a Federal law was enacted forbidding Chinese subjects from importing opium into the United States. In time additional restrictive legislation was enacted in several states, but it was not until about a decade ago that more general interest was manifest in protecting the public against the indiscriminate use of these baneful agents. With one exception every state and territory in the Union has on its statute books some law, however limited or circumscribed, governing the sale of certain habit-forming drugs. The Federal Food and Drugs Act and state laws similar to the Federal law are undoubtedly considered mild restrictive measures and contemplate a diminution of the use of certain drugs. These laws have undoubtedly accomplished much good, but it is well known that in some cases where no specific state legislation exists against the indiscriminate selling of cocaine, morphine, opium and certain other life-wrecking remedies, habitués seek out for their use those products which contain the greatest amounts of the desired drugs. Fortunately, however, a goodly number of state laws forbid the sale of cocaine, morphine, opium, etc., or any of their salts or preparations containing any of the foregoing substances except upon original prescriptions of legally qualified physicians. Some of these laws exempt preparations containing less than given quantities of cocaine, morphine, opium, etc., their salts and derivatives, and, with certain restrictions, liniments, ointments, diarrhœa mixtures, etc., containing same, but a number of states do not possess any specific restrictive measures whatever. In order that existing conditions may be clearly realized a brief résumé will be here given of the Federal, state and territorial laws.

FEDERAL LAWS.

The importation of opium by Chinese subjects into the United States was prohibited in 1887, and the traffic of opium in China and certain Pacific islands by citizens of the United States was forbidden in 1902. The high duty of $6 per pound placed upon smoking opium and opium containing less than 9 per cent. of morphine

by the tariff law of 1897 probably also serves as a restrictive measure to the consumption of these products, which appear to be used only for improper purposes. The Food and Drugs Act of June 30, 1906, restricts, by information, the sale and use of certain habit-forming drugs, their derivatives and preparations, by requiring the quantity or proportion present to be declared upon the label. The restrictions relative to imported products, however, are more stringent, in that this law forbids entry not only to drugs adulterated or misbranded within the meaning of this Act but, in addition, forbids entry to a drug which is " dangerous to the health of the people of the United States or is of a kind forbidden entry into, or forbidden to be sold or restricted in sale in the country in which it is made or from which it is exported, or is otherwise falsely labelled in any respect, . . ." From this clause it is clearly evident that drugs dangerous to the health of the people of the United States, or of a character forbidden to be sold in or restricted in sale in the country of production or exportation, " shall be refused admission " even though they comply with the adulteration and misbranding features of the Act. It is under this clause that smoking opium is debarred.

With the exception of the Post Office Appropriation Act which forbids the use of any money appropriated thereby for carrying through the mails any cocaine or derivative of cocaine for the fiscal year beginning July 1, 1908, there is no Act which regulates or restricts the shipping direct to the consumer or otherwise, into interstate commerce, which is now a common practice, pernicious habit-forming drugs. In many cases they are shipped into jurisdictions where stringent restrictive laws prevail. The state officials are helpless. Several bills have been introduced into the present Congress for the purpose of restricting such evils. These bills will be considered in the latter part of this article.

STATE AND TERRITORIAL LAWS.

It will be impossible to consider more than general principles, and for this reason if two or more states have the same or similar laws a résumé of the law will be considered under the first state, or the District of Columbia, taken alphabetically, and for other states, etc., having similar laws, suitable references will be made together with the more important variations. The general headings advise what particular features obtain in each jurisdiction. In order to save repetition and some space a number of explanatory statements

will be made here: *Specific regulations* means laws specifically restricting the sale of certain habit-forming drugs; *poison regulations,* restrictions contained in poison laws; *misbranding regulations,* the enforced declaration of the quantity or proportion of certain agents. In general it is unlawful to sell, furnish, give away or otherwise dispose of, by retail, the drugs, their salts and derivatives, enumerated in connection with each state, except upon the prescriptions of legally qualified physicians, dentists or veterinarians, which prescriptions must be dated and can be refilled only upon written notice from the original prescriber, and must be kept on file, subject to official inspection for varying lengths of time. The name of the prescriber and the name and address of the patient are also usually required to appear in the prescription. In many states the sale of preparations containing considerable amounts of certain habit-forming drugs is also restricted. As a rule physicians are forbidden to prescribe habit-forming drugs to habitués, except in good faith and then only to such persons as are under their personal care.

Alabama (1907).—Specific and poison regulations. Cocaine, eucaine, morphine and salts of the preceding. Prescriptions calling for more than 5 grains cannot be filled unless prescribed with other drugs.

Alaska (1885).—Specific, poison and misbranding regulations. Opium and preparations of opium.

Arizona.—Poison and misbranding regulations only.

Arkansas (1905).—Specific, poison and misbranding regulations. Cocaine, morphine, opium, codeine, heroin, their salts, compounds and preparations containing same, except preparations containing less than 2 grains to the fluidounce.

California (1907).—Specific, poison and misbranding regulations. Cocaine, morphine, opium, codeine, heroin, their salts, compounds and preparations containing same, except preparations containing less than 2 grains to the fluidounce.

Colorado.—Similar to Arizona.

Connecticut (1905).—Specific, poison and misbranding regulations. Cocaine, eucaine, their salts and any preparations containing same. The misbranding regulation exempts from declaration the amounts of certain drugs when present in remedies for external use only.

Delaware is the only state which does not possess any restrictions whatever to the sale of these drugs.

District of Columbia (1906).—Specific, poison and misbranding regulations. Cocaine, morphine, opium, chloral hydrate, their salts and preparations containing any of the foregoing. The above restrictions do not apply to Dover's powder, not exceeding 20 grains per sale, nor to preparations containing not more than 2 grains of opium, or ¼ grain morphine, or ¼ grain of cocaine, or 2 grains of chloral hydrate to the fluid- or avoirdupois ounce;

nor to opium preparations sold in good faith for diarrhœa and cholera when accompanied by a caution label against habitual use; nor to liniments or ointments when plainly marked "for external use."

Florida (1903).—Specific, poison and misbranding regulations. Cocaine and its salts. (1881) Morphine sulphate is required to be labelled with a scarlet label.

Georgia (1907).—Similar to the District of Columbia with the following differences: Includes heroin, the eucaines, their salts and compounds; excepts Dover's powder unconditionally, and preparations containing not more than 4 grains of opium, or 1 grain of morphine, or ¼ grain of heroin, or ⅛ grain alpha- or beta-eucaine, or more than 20 grains of chloral hydrate in the fluid- or avoirdupois ounce. The law of 1887 permitted the sale of opium and its preparations containing more than 2 grains to the ounce, on prescription only, to habitués after receiving instructions in writing from a near relative that such person is addicted to the use of the drug. (1884) Morphine salts must be wrapped in scarlet paper with white letters.

Hawaii (1896).—Similar to Alaska. Contains misbranding regulation.

Idaho.—Poison regulations only.

Illinois (1903).—Similar to Arkansas except does not contain misbranding regulation.

Indiana (1907).—Specific, poison and misbranding regulations. Cocaine, morphine and opium.

Iowa (1907).—Specific, poison and misbranding regulations. Cocaine, eucaine, coca (Erythroxylon Coca), their derivatives and preparations containing any of the foregoing.

Kansas (1901).—Specific, poison and misbranding regulations. Cocaine, morphine and chloral hydrate.

Kentucky (1902).—Similar to Florida excepting scarlet wrapper.

Louisiana (1908).—Specific, poison and misbranding regulations. Cocaine, "crown" or any concoction in which cocaine is the principal ingredient. This state also has a regulation which prohibits the sale of opium, cocaine and their derivatives (excepting paregoric), and chloral hydrate, in any form except to pharmacists, physicians, dentists and veterinary surgeons. Another regulation, however, forbids the refilling of prescriptions containing these drugs, which gives the impression that prescriptions containing same may be filled.

Maine (1889).—Same as Florida.

Maryland (1906).—Similar to the law of the District of Columbia, with the following differences and exceptions: No misbranding regulations; includes heroin and the eucaines, their salts and compounds. The restrictions, however, do not apply to Dover's powder, paregoric, laudanum, or to bonafide proprietary medicines containing codeine, or preparations containing not more than $^{2}/_{15}$ grain morphine or ¼ grain heroin, or 10 grains of chloral hydrate to the fluid- or avoirdupois ounce.

Massachusetts (1908).—Specific and poison regulations. It is unlawful for any person, firm or corporation to sell, exchange, deliver, have in his possession or custody with intent to sell, exchange, deliver or give away any cocaine, eucaine, their salts, or any synthetic substitute for the aforesaid or

any preparation containing same. It is unlawful for any person, firm or corporation to manufacture any catarrh remedy or patent or proprietary preparation containing cocaine or eucaine or any synthetic substitute.

Michigan (1907).—Specific and poison regulations. Cocaine, morphine, eucaine, their salts and derivatives. The law of 1905 exempts morphine in pill and tablet form when sold in quantities not less than ⅛ ounce original packages, but the law of 1907 exempts "morphine" itself when sold in not less than the above quantity in original packages.

Minnesota (1905).—Similar to Florida, except misbranding regulation.

Mississippi (1900).—Similar to Florida, except misbranding regulation. The law of 1886 requires a scarlet wrapper with white letters for cocaine, morphine and their salts.

Missouri (1905).—Similar to Arkansas.

Montana.—Similar to Idaho.

Nebraska (1905).—Similar to Florida, except scarlet wrapper.

Nevada.—Similar to Idaho.

New Hampshire (1907).—Misbranding regulations. The poison schedule covers only arsenic, corrosive sublimate, nux vomica, strychnine and prussic acid.

New Jersey (1908).—Specific, poison and misbranding regulations. Cocaine, alpha- or beta-eucaine, their salts and any preparation containing any of the foregoing, morphine, opium, codeine, chloral hydrate, or any derivative of chloral hydrate. The New Jersey law contains several excellent features which deserve particular mention. In the first place, it forbids the bringing into the state of any substance or mixture of substances which shall be purchased or otherwise obtained contrary to the laws of such state. It also requires that the "wholesale dealer or registered druggist shall, before delivering any of said articles, make or cause to be made in a book kept for that purpose, an entry of the sale thereof, stating the date of the sale, the quantity, name and form in which sold, the name and address of the person purchasing the same and by whom the entry is made, and the said book shall be always open for inspection by the proper authorities, and shall be preserved for at least five years after the date of the last entry made therein."

New Mexico (1897).—Similar to Arizona.

New York (1907).—Specific and poison regulations. Cocaine, eucaine, their salts and preparations containing same. The law also requires that "each manufacturer and each wholesale dealer in drugs shall, before the delivery or at the time of the receipt, as the case may be, of any such drug, enter or cause to be entered in a book kept by them respectively for that purpose a record of the purchase and sale of such drug, stating the date of purchase and the name and address of the person from whom purchased; the date of sale and the name and address of the person to whom sold; the quantity, name and form in which sold and a description of the package or container in which sold and how sealed, and there shall also be entered in such book at the place of such record a statement that such drug was sold or purchased, as the case may be, in the original package; that the seals thereon were undamaged and unbroken, and the labels were attached

thereto as herein provided and were not in any manner defaced or damaged, which statement shall be signed by the person selling such drug and the person purchasing such drug in the books herein required to be kept by them respectively."

North Carolina (1907).—Similar to the District of Columbia law, including, however, eucaine, but exempting chloral hydrate. Certain differences also exist, namely, the exemption of Dover's powder, unconditionally, and preparations containing not more than ⅛ grain of cocaine, or ⅛ grain eucaine, or ¼ grain heroin to the fluid- or avoirdupois ounce. The law of this state contains the peculiar proviso that a druggist may sell these products to habitués personally known to him, although physicians are apparently forbidden to write prescriptions for habitués. It is interesting to note also that the law of 1905 exempts sales of laudanum and paregoric or other preparations containing not more than 30 per cent. of cocaine, morphine or opium.

North Dakota (1907).—Similar to Florida, except scarlet wrapper.

Ohio (1902 and 1908).—Specific, poison and misbranding regulations. Cocaine or its salts or any preparation containing any of the foregoing; morphine or its salts or any opium alkaloids or their salts; morphine sulphate, however, may be retailed when sold in not less than ⅛ ounce original packages.

Oklahoma (1897).—Similar to Arizona.

Oregon (1885).—Specific and poison regulations. Cocaine, opium, morphine, eng-she, or cooked opium, and chloral hydrate may be sold on pharmacist's prescription.

Pennsylvania (1903).—Similar to Arkansas; no misbranding regulation.

Philippine Islands (1907).—Specific, poison and misbranding regulations. All imported opium shall be delivered by the custom authorities to the Collector of Internal Revenue who shall supervise its distribution. "Every dispenser of opium, pharmacist, and second class pharmacist, shall keep a book in which he shall enter, in Spanish and English, the full quantity of opium received by him from every source, the date on which the same was received, the person from whom received, the price thereof, the date and hour of each and every sale or delivery made by him, the quantity and kind of opium sold or delivered by him, the name and authorization of the person purchasing or receiving the same, the quantity and kind of opium transferred on permit, the date of such transfer, the name and address of the person to whom transferred, together with the number of the permit for withdrawal or removal, and such other information as may be prescribed by the Collector of Internal Revenue." It is also unlawful to be in possession of any cocaine, opium or eucaine, their derivatives or any preparation containing same, except when duly licensed and then only for medicinal purposes. It is also unlawful, excepting duly licensed persons, to be in possession of "any pipes, hypodermic syringes, and apparatus or paraphernalia for smoking or using opium" in any manner. Possession of any of the above "shall be deemed prima facie evidence" of violation of the law, unless the person is duly licensed or is in possession of a bonafide prescription.

Porto Rico.—Misbranding regulation only.

Rhode Island (1906).—Similar to the District of Columbia law but also covers heroin and the eucaines, their salts and compounds. The law also provides for the following differences and exemptions: exempts preparations containing not more than 6 grains of opium, or $^1/_{16}$ grain cocaine in the fluid- or avoirdupois ounce. Dover's powder is not exempt.

South Carolina (1907).—Similar to Florida, except scarlet wrapper.

South Dakota.—Similar to Arizona.

Tennessee (1901).—Similar to Arkansas.

Texas (1905).—Similar to District of Columbia with certain slight differences, namely, preparations are exempted which do not contain more than $^1/_{16}$ grain of cocaine, or $^1/_8$ grain of morphine to the fluid- or avoirdupois ounce. Dover's powder is not exempted.

Utah (1907).—Similar to Arkansas. Opium cannot be sold or given to persons under eighteen years of age.

Vermont.—Similar to Arizona.

Virginia (1908).—Similar to District of Columbia but markedly different. Does not include chloral hydrate. The selling of cocaine, the eucaines, or any mixture containing the same, except on prescription, is a felony. Any person not duly authorized by the Act who shall have "in his possession cocaine, or alpha- or beta-eucaine, or any mixture of either with intent to sell (at retail), give away or otherwise dispense the same, he shall be deemed guilty of a felony." It is also unlawful to sell, furnish, or give away "any morphine, heroin, opium and preparations thereof containing a higher percentage of morphine than tincture of opium of the strength ordered by the United States Pharmacopœia, or any salt or compound of the foregoing substances," except on prescription. The above, however, does not apply to preparations containing not more than $^1/_3$ grain morphine, or $^1/_4$ grain heroin to the fluid- or avoirdupois ounce. Dover's powder is exempted unconditionally.

Washington.—Similar to Arizona.

West Virginia (1907).—Similar to the District of Columbia with certain additions and different exceptions. Includes heroin, the eucaines, their salts and preparations. Exempts Dover's powder unconditionally, and preparations containing not more than $^1/_8$ grain cocaine, $^1/_8$ grain eucaine, 10 grains chloral hydrate, $^1/_4$ grain heroin, or 2 grains codeine in a fluid- or troy ounce.

Wisconsin (1906).—Similar to the District of Columbia with certain additions and differences. Contains no misbranding regulation. Includes heroin, the eucaines, their salts and preparations. Dover's powder is not exempt. Other different and additional exemptions are preparations containing not more than $^1/_8$ grain of cocaine, $^1/_8$ grain of the eucaines, $^1/_4$ grain of heroin, or 10 grains chloral hydrate in the fluid- or avoirdupois ounce.

Wyoming (1903).—Specific and poison regulations. Cocaine, opium and chloral hydrate, derivatives and preparations containing same.

It requires but a casual perusal of the above résumé to be convinced that many of the states and some of the territories have excellent laws which, if properly enforced and strengthened as time

requires, will ultimately stamp out drug addictions. It must also be stated that some of the state officials are laboring strenuously to enforce these laws and are doing much toward eradicating the curse, but there are several features beyond their control to which attention will now be directed.

The laws of one state are unable to reach parties sending habit-forming drugs into its borders from another jurisdiction, although the jurisdiction from which the drugs are sent may prohibit the selling, locally, of similar drugs. For example, the sale of cocaine is prohibited in the state of Maryland excepting on physician's prescription, but this does not prevent a party in Maryland from shipping cocaine into the District of Columbia, where a similar law prevails, to the consumer, peddler, or any other irresponsible party; in fact this is now not an uncommon practice. I was informed some time ago that a certain wholesale druggist in an adjacent state was shipping a cocaine-laden catarrh powder to an habitué in the District of Columbia. Steps were immediately taken to determine whether or not this representation was correct, and as an evidence of the correctness of the statement I have here one of the three packages actually sent to a supposed drug habitué.

Here I have a cocaine preparation intended for the treatment of the tobacco habit, placed on the market by an M.D., as is plainly shown by the label. Think of treating the tobacco habit by means of a cocaine product! Here I have one of the many drug-addiction cures containing 24 grains of morphine to the ounce. Here we have the scriptural 99 saved extending aid to the one lost. The product contains 7 grains of morphine sulphate to the ounce, and is supplied by a Chicago druggist. This "Asthma, Whooping-Cough, Etc." preparation contains 110 grains of chloral hydrate to the ounce, a most pernicious mixture, sent directly into the home without any indication whatever respecting its deadly nature. A teaspoonful may send a child to eternity. A number of other samples containing habit-forming drugs were exhibited, for example, an asthma preparation containing cocaine, a teething-syrup containing the same insidious drug, a morphine-bearing "Infant's Friend," etc.

The above are only a few of the many instances which we have on record showing in what manner the District and state laws are violated daily for want of a satisfactory Federal law regulating the shipment into interstate commerce of these pernicious products.

During the first session of the 60th Congress several bills were

introduced, the object of which is to provide for some regulation. During the second session of the same Congress two other bills were introduced, for the purpose of controlling the importation of various forms of opium. The Gallinger Bill, S. 4892, forbids the importation of all forms of opium and compositions containing any opium, excepting by duly appointed government officials who are also charged with the final disposition of the opium. A similar but much more stringent law, covering not only the above products but cocaine and the eucaines as well, was enacted by Congress in 1907 for the Philippine Islands. If this law is properly executed the illegitimate use of opium, cocaine and the eucaines will be short-lived. It was thought by many that the Gallinger Bill would meet with severe opposition, yet the belief prevailed that this country was in need of a Federal antinarcotic law drafted along the lines of the American Pharmaceutical Association's model antinarcotic law. The principles of this model law are embodied in the two Mann bills, one, H.R. 19240, introduced by request March 13, 1908, and the other, H.R. 21982, introduced May 12, 1908. In fact, these bills are modifications of the District of Columbia antinarcotic law passed by the United States Congress in 1906, modified so as to be applicable to importations, interstate commerce and territorial transactions. The law also limits the amounts of certain prescribed drugs which may be called for in a single prescription. Each of the bills also contains a poison label section, a feature which has been in existence in most of the states for many years. The bill has been severely criticized by a number of interests.

It is estimated that 150,000 ounces of cocaine hydrochloride is used yearly in the United States. Of this quantity it is estimated that at least one-half is employed for improper purposes. It is also estimated that over one-half of the amount of opium and morphine imported into the United States is used illegally.

During the first eight years of the present decade beginning with the year 1900, the average amount of crude opium imported into the United States was 8,027,792 ounces per year, of smoking opium the average per year was 2.431,104 ounces, and of morphine and its salts 21,731 ounces. These data should certainly be sufficient to warrant some activity along the line of regulating the sales of these pernicious, life-wrecking agents and preparations containing same.

THE CENTENARY OF CHARLES DARWIN.[1]

By Henry Kraemer.

It is not my purpose to take the time of the meeting by attempting to give a résumé of the work of Charles Darwin or an estimate of the influence and character of this savant of the nineteenth century, the centenary of whose birth is being celebrated throughout the civilized world at this time.[2] I think, however, that it is but fitting for a professor of natural science of this college to place on record a minute that we, in this centenary year, paused along with other scientists, and paid our tribute of praise and gratitude to this liberator of thought.

Darwin was the author of something over twenty books and nearly one hundred papers, about one-third of his writings being on botanical subjects. It was his book, "The Origin of Species by Means of Natural Selection," published on November 24, 1859, which was his epoch-making work, freeing us, as it did, from the shackles of the past, or, in other words, freeing us from the necessity of considering the supernatural in our study of the biological sciences. While this is true, it is probably safe to say that apart from his masterful deductions his other most enduring contribution to science lies in the impetus given to scientific research by his comprehensiveness of vision, his ability to study natural phenomena at first hand, to discriminate between facts and opinions, and finally to connect facts in an orderly sequence. In short, it is the Darwinian method which has proved to be such a boon in scientific research.

Darwin furnished a conspicuous example of the law of heredity for which he claimed so much. His grandfather on his paternal side was Dr. Erasmus Darwin, a poet and philosopher, his name being often coupled with that of Lamarck, as an early evolutionist; and on his mother's side his grandfather was Josiah Wedgwood, the inventor of wedgwood-ware, formerly used much in making mortars for the use of apothecaries. His father, Robert Waring Darwin, F.R.S., was an eminent physician, and it was his desire that Charles should likewise study medicine. Accordingly, in 1825, he was sent to Edinburgh, where, he says, he found the lectures on geology and

[1] Read at the Pharmaceutical Meeting of the Philadelphia College of Pharmacy, held February 16, 1909.

[2] Charles (Robert) Darwin was born February 12, 1809, at Shrewsbury (England).

zoology incredibly dull, although he was at that time engaged in collecting and studying mineral and zoological specimens, and although he afterwards attained such eminence in each of these sciences. Darwin's father, learning that he did not like the study of medicine, decided that he should fit himself to be a clergyman, and thus after two years at Edinburgh he was sent to Christ's College, Cambridge. Here he attracted the attention of Professor Henslow, the mineralogist and botanist, who became his "dearest friend," directed him in his natural history studies, and aroused in him that enthusiasm which characterized the remainder of his career as a scientist.

Through the reading of Humboldt's "Personal Narrative" Darwin acquired a desire to travel, and this opportunity soon offered itself. Professor Henslow not only used his influence in securing for him the privilege of going on the voyage of H. M. S. *Beagle* as naturalist under Captain Fitz-Roy on a surveying tour round the world, but strongly advised him to do so. The voyage lasted from December 27, 1831, to October 2, 1836, nearly five years, and it was on this trip that Darwin collected so much of the material that formed the basis of his future work in geology, zoology, and botany. He described carefully his observations each day in his famous Journal of the Voyage, and altogether it is no wonder that Darwin looked upon this voyage as the most important event in his life and as one that determined his whole career.

Then, for more than twenty years he experimented, and pondered on his observations and those of others, before giving his final conclusion to the world. This was his theory of natural selection as a factor in organic evolution, and his discussion of this subject was set forth, as already pointed out, in his "Origin of Species." Darwin takes as his starting point the fact that in the lives of organic beings there is a struggle for existence, and that those which survive in this struggle are those possessing some favorable qualities. These qualities arise or originate as slight variations or modifications, which are transmitted through inheritance, and preserved and accumulated through natural selection. That is, favorable variations give the organism an advantage, and it survives and they are preserved or perpetuated. Thus, through gradual modification in the course of time new varieties and species come to be recognized

Darwin felt that if natural selection was one of the factors in evolution, light would be thrown on the subject by careful studies

on plants and animals under domestication, and his observations, together with those of others on the marked improvement brought about by man's selection, confirmed him in this view. To this topic alone he devoted two volumes under the title "Variation of Animals and Plants Under Domestication."

In enunciating his doctrine of natural selection, or the Survival of the Fittest, as Herbert Spencer termed it, Darwin was strongly assailed on all sides, even by naturalists and scientists themselves, as up until that time the majority of naturalists believed that species were fixed and distinct creations, not even Lyell or Hooker having previously considered that species were mutable. Fortunately, he was supported by Alfred Russell Wallace who had simultaneously arrived at the same conclusion, Huxley, Asa Gray, Hooker, Spencer, and others. To-day we have neo-Darwinians, Lamarckians, neo-Lamarckians, mutationists, Weismannians and Mendelians, and so on,—all battering away at Darwin's doctrines of heredity and evolution, but these doctrines bid fair to stand for an indefinite period.

It is not too much to say that Darwin's work has formed the basis of a newer geology, botany and zoology. His book on the "Descent of Man" has been the basis in the development of anthropology; while his book on "The Expression of the Emotions in Man and Animals" has made a rational psychology possible, and the celebrated geologist, Geikie, said, "No man of his time exercised upon the science of geology a profounder influence than Charles Darwin."

Darwin touched life at every point. Like Aristotle, he believed that the essence of a living thing is not what it is made of, nor what it does, but why it does it. His love of science was great, as he twice states in his Autobiography. In addition to this, his ambition was to be esteemed by fellow naturalists like Lyell and Hooker, caring nothing for public applause, although pleased if his works were understood or appreciated. Twenty per cent. of his life was made up of years of illness, and he conserved his time so that no moment was wasted. Poulton has recently suggested that it was largely because of the relatively few hours a day that he could work, he gave up his interest in poetry, music and art in later life.

He attached relatively little importance to priority of discovery, and said of some of his fundamental discoveries which had given him great satisfaction, and which were subsequently worked out more fully, that if he failed to impress his readers he who succeeds in

doing so deserves all the credit. His generous treatment of the writings and observations of others, whether published or simply in letters, was proverbial. It is true, he made some mistakes, which he apparently knew better than others, and in a letter to Huxley on one occasion, said, "I have sometimes amused myself with thinking how I could best pitch into myself, and I believe I could give two or three good digs." Darwin was not a controversialist, being advised as he said by Lyell, "never to get entangled in a controversy, as it rarely did any good and caused a miserable loss of time and temper."

If one wishes to spend a few hours profitably, one cannot do better than to read "The Life and Letters of Charles Darwin," including an autobiographical chapter, by his son Francis Darwin.

And if one desires to get some idea of the physiognomy of Darwin, let him go to the American Museum of Natural History in New York, where there was unveiled, last Friday (February 12th), a bronze bust of him, which is clever in conception and in execution. I shall never forget, as I saw the canvas removed, the impression I first received, as it seemed that I could think of nothing but Mount Shasta. The eyes, overarched with the prominent brows, seem as if they could look into the noon-day sun and penetrate its secrets; the nose and lips both indicate strong character, yet tempered with kindliness, and the massive wrinkled brow also adds to the distinction of this master mind of the nineteenth century.

It is a matter of pride that in the city of Philadelphia the epoch-making work of Charles Darwin first received official recognition, and it is also a matter of congratulation that in America he immediately found some of his most ardent friends and supporters.

PHILADELPHIA COLLEGE OF PHARMACY.

FEBRUARY PHARMACEUTICAL MEETING.

The stated pharmaceutical meeting of the Philadelphia College of Pharmacy was held Tuesday, February 16, at 3 o'clock, with Prof. Joseph P. Remington in the chair. Interest in the meeting was heightened by the presence of Caswell A. Mayo, editor of the *American Druggist,* and of Otto Raubenheimer, the Brooklyn chemist and pharmacist.

Mr. Mayo was the first speaker on the program and gave an instructive address on "The Use of Ampuls in the Preservation and Dispensing of Hypodermic Solutions," which will appear in a subsequent issue of the JOURNAL. All of the processes involved in the making, filling, and sterilizing of ampuls was amply demonstrated, not only by means of apparatus which the speaker had fitted up, but also by the use of apparatus and products furnished by manufacturers of ampuls at home and abroad.

In reply to the question as to whether ampuls would become popular with American physicians, Mr. Mayo said that this was somewhat problematical, for the reason that American physicians are not in the habit of administering medicines themselves, as is customary in France and Italy in the use of ampuls.

Professor Remington said that he supposed they would find more use in army practice, as instanced by Mr. Mayo in the use of ampuls of quinine by the Italian Army, or in hospitals, where the hypodermic injections could be made by nurses.

Mr. Raubenheimer read an interesting paper having the title, "History of the Medicinal Earths and Cataplasma Kaolini," by Dr. Hermann Schelenz, a German Apotheker, of Cassel, which he had translated from the German (see March number of AM. JOUR. PHARM., p. 111). Before reading the paper Mr. Raubenheimer called attention to a copy of the "History of Pharmacy," by Schelenz (see March number of AM. JOUR. PHARM., p. 151).

In reply to a query by Mr. Franklin M. Apple as to whether the virtues of cataplasm of kaolin were not due to the glycerin, Mr. Mayo referred to a statement by Mr. A. M. Roehrig to the effect that he formerly knew a physician in Nebraska, who sometimes prescribed a mixture of Fuller's earth, glycerin, and laudanum. This mixture was used in the Civil War, and when the other ingredients were not obtainable blue clay alone was used.

Mr. Raubenheimer said that, as already mentioned in his paper, references to the medicinal virtues of clay could be traced back to the writings of Dioscorides.

Mr. George M. Beringer stated that the British Pharmaceutical Codex had increased the percentage of glycerin in the cataplasm of kaolin, and said that a practical difficulty was thus introduced, in that a smeary mixture resulted.

Professor Remington, in commenting on the paper, said he did not imagine that a clay poultice could form the subject of such a classical paper. He said that the principal difficulty in making the cataplasm of kaolin was that of getting kaolin having uniform absorptive property, and that it was not a question of the proportion of the different components, as in one instance the product would be crumbly and in another more or less liquid. He therefore claimed that there should be a test to determine the relative glycerin-absorption power of the kaolin, or a purity rubric for kaolin.

Prof. Henry Kraemer read a paper on "The Centenary of Charles Darwin" (see p. 196).

Prof. E. Fullerton Cook followed with some notes on "Drug Store Conveniences," which will be published in a later issue of the JOURNAL. In this connection he exhibited a vapor-alcohol stove which has the advantage of giving a sustained moderate heat in the presence of draughts and is thus adapted for those operations where a comparatively low temperature is required.

A cordial vote of thanks was tendered the speakers of the afternoon.

MARCH PHARMACEUTICAL MEETING.

The stated pharmaceutical meeting was held Tuesday, March 16, with George M. Beringer, a member of the Board of Trustees, presiding.

Joseph W. England read a brief paper giving a review of the literature relating to the "Enzymes of Cow's Milk" (see p. 177). In commenting upon the paper Prof. Chas. H. LaWall said that he had been conducting some experiments with reference to the enzymes in condensed milks, and found that they, particularly those condensed *in vacuo*, gave a positive reaction with Dupouy's test and a negative one with the Wilkinson and Peters method, which showed that an intermediate temperature had been employed in their preparation. Mr. Beringer remarked that the manufacturers are beginning to take cognizance of the presence of the enzymes in milk.

Prof. Henry Kraemer gave a talk and demonstration on methods of disinfection and the technic employed in the examination of sputum for tubercle bacilli. Professor Kraemer first called attention to the fact that the work of disinfection alone in infectious diseases is, as stated by Dr. Lawrence F. Flick, a very extensive project, and he said that druggists are not only asked to co-operate with boards of health and physicians in private practice in carrying out this work, but that their training and knowledge of chemistry especially qualify them to do so. He stated that there are four degrees of temperature which are to be considered in relation to micro-organisms, namely, (1) a zero temperature, at which the organisms are inactive; (2) a temperature of 25°–40° C., at which they manifest growth or activity; (3) a temperature of 80°–100° C., at which the organisms are killed; and (4) a temperature of 110°–120° C. which is required to kill the spores; and that there are likewise four degrees of concentration of chemicals which should be borne in mind in practical work: (1) very weak solutions, which do not affect the organisms; (2) slightly stronger solutions, which stimulate growth; (3) solutions which kill the organisms but do not affect the spores; and (4) still stronger solutions which kill the spores. The last degree of concentration of a chemical mentioned, as well as a temperature of 110°–120° C., is classed as a germicide, while a temperature of 80°–100° C. and a concentration of a chemical solution sufficient to kill the organisms only are classed as antiseptics. For this reason, it was pointed out that all work of disinfection by means of chemicals, whether of rooms and dwellings, clothing and other articles, or of excreta, should be carried out quantitatively, and that it should be carried on by those having a knowledge of the subject, there being not only a difference in the toxic power of different chemicals, but also a marked difference in the degree of resistance of different micro-organisms. In speaking of the disinfection of rooms and dwellings the use of formaldehyde was recommended, and the method of generating the gas from formaldehyde solution and potassium permanganate demonstrated. The necessity of having a moist atmosphere during the generation of the gases in disinfection was emphasized, and the statement made that it is usually necessary to make special provision for insuring the necessary degree of humidity, which should be near the point of saturation.

After describing the tubercle bacillus and giving the methods for

its detection, Professor Kraemer exhibited forms of containers used in collecting samples of sputum, to which a 5 per cent. solution of carbolic acid should be added.

In discussing the subject of disinfection, Mr. Beringer also spoke of the importance of the presence of moisture, and said that in the generation of formaldehyde from the solution, it polymerizes unless there is a sufficient supply of moisture. Mr. England spoke of the opportuneness of the demonstration, and referred to the work which is being carried on by Dr. Rosenberger, of Jefferson Medical College, for the detection of tubercle bacilli in blood.

A discussion on formulas for medicines which may be dispensed by pharmacists, devised according to the plan suggested by Dr. McCormack and Dr. Wiley (see AM. JOUR. PHARM., Feb., 1909, p. 56), was opened by George M. Beringer, who said that the proposition is one which affects every pharmacist, especially those having the ethics of pharmacy at heart, and that it is one which appeals to the pharmacist from the ideal point of view, but that when it comes to the practical consideration of it a number of difficulties present themselves. In illustration, he presented the question as to who will decide what a minor ailment is, and said that a cold may be the signal of pneumonia, and a headache the forerunner of typhoid fever. He, moreover, felt that druggists should not have this responsibility, and was of the opinion that physicians would not like to have druggists assume responsibility in the early stages of disease. In this connection he stated that druggists already answer calls for diarrhœa mixtures, cough medicines, and similar preparations. Then, alluding to the subject of patent medicines, he said that druggists should not encourage their sale, and referred to a suggestion made by him in a paper presented to the New Jersey Pharmaceutical Association a few years ago, that before medicines are advertised in the papers the formulas should be submitted to some authority for criticism.

The discussion was also participated in by the following: Warren H. Poley, Henry C. Blair, W. L. Cliffe, C. B. Lowe, F. M. Apple, William E. Lee, John K. Thum, and Henry Kraemer, and the consensus of opinion of the retail druggists was that the plan proposed did not appear practicable at the present time. It was brought out that the custom generally approved by retail druggists, is to supply such medicines as are called for, except in cases where inquiry shows that their use would be inadvisable, and that in all cases

where it seems at all necessary the patients are advised to consult a physician, an attempt at diagnosis not being approved. Moreover, the feeling seemed to be that while druggists do not approve of the use of patent medicines they are justified in selling them so long as physicians prescribe them and that, therefore, the elimination of this class of remedies depends upon the physician, on the one hand, and upon the education of the public, on the other.

Mr. Blair quoted figures to show that there has been a marked falling off in the sale of patent medicines the last year or so, but stated that there are indications that strong efforts will be put forth to revive the business in this line.

Professor Kraemer said that druggists should share in the work of educating the public, and that if they were not in a position to refuse entirely to sell nostrums, they should discourage their use at every opportunity. He took the position that they should at least refuse to sell patent medicines advertised as consumption remedies, and said that he hoped the question of the Government's granting serial numbers to this class of medicines would be taken up for discussion.

Mr. Poley spoke of the difficulty of overcoming the influence of those advertisements of patent medicines which appear in the newspapers as reading matter.

A communication bearing on this subject was received from M. I. Wilbert, who after referring to the awakening of the public in regard to food preservatives, writes as follows:

"Pretty much the same conditions will soon prevail in regard to proprietary medicines and nostrums and it would be well for the retail druggists of this country to take cognizance of this possibility and to shape their business so that when the people of this country awake to a proper appreciation of the injustice that has been done them they will not be likely to place the blame on the least interested beneficiary of the sale of nostrums. In a lecture delivered in this college recently (AM. JOUR. PHARM., February, 1909, p. 56), Dr. H. W. Wiley pointed out that the American people, more than any other, were the victims of the drug habit, and that the direct cause for this drug habit was to be sought in the false and really misleading claims that are made in connection with nostrums or so-called patent medicines. To the thinking pharmacist it must be evident that once the American people realize that the retail druggists of this country have indiscriminately sold them worthless or even harmful prepara-

tions, in the guise of sure cures, and that at least some of these preparations have led to the formation of drug habits, either general or specific, and that the retail druggist, because of his special knowledge and training, knew of the uselessness and possible harmfulness of these compounds, he, and not the manufacturer, will be held responsible for their sale.

"In this same connection it is interesting to note that Dr. Wiley makes practically the same suggestion regarding the possible development of a line of household remedies that was made by Dr. McCormack at the meeting of the American Pharmaceutical Association, in New York, in 1907.

"It will be remembered that at that time Dr. McCormack discussed rather freely what he considered to be some of the more evident shortcomings in the present-day make-up of the retail drug business. Some of his statements were objected to by men who either did not grasp, or were not willing to allow other members of their calling to grasp, the true object of the address, and so far as the retail drug trade is concerned little or nothing has been done to remedy the evils that were pointed out.

"In the course of his address Dr. McCormack pointed out that, quite aside from the moral wrong involved in the nostrum business, the trade has only enriched the manufacturer and has always been an unprofitable curse to the retail druggist. He also pointed out the possibility of developing a line of unobjectionable household remedies that might be sold by the retail druggist with profit to himself, and serve to displace the frequently harmful nostrums that are now sold.

"At the meeting of the American Medical Association, in Chicago, the following summer (see AM. JOUR. PHARM., 1908, pp. 393–396), Dr. McCormack recommended that a conference committee be appointed by the American Medical Association and the American Pharmaceutical Association to consider the possibility of bringing about reforms in connection with the use of drugs, a return to scientific prescription writing, the development of a line of unobjectionable household remedies, and other matters of interest to the members of the two professions and bearing on their mutual duties to the public at large.

"The American Medical Association has provided for such a conference committee and such a committee would undoubtedly be in position to accomplish much good if the retail druggists of the

country would but awaken to a proper realization of their duties to themselves, to the medical profession, and to the public at large, whose material interests, well-being and even lives are, to a considerable extent, in their care.

"With the more or less concerted efforts that are being made at the present time to advance what has become known as 'The U. S. P. and N. F. Propaganda,' it would appear as though the retail druggists of the country had an excellent opportunity to demonstrate that they are really interested in the science of their calling and in the promotion of the public health, and that they are not alone willing but also able to live up to the responsibilities that are imposed on them, by the legislation that has been enacted for their protection and guidance, making them responsible for the drugs and medicines dispensed and sold. The subject is certainly one that is deserving of careful thought, particularly at this time when the popular wave for honesty and publicity is so wide-spread and is ever assuming greater force and volume."

Among the exhibits were a metal Minot Slide Cabinet for microscope specimens, manufactured by Peter Gray & Sons of Cambridge; a specimen of opium, the interior of which was filled with clay, presented by the Smith, Kline & French Co.; and specimens of drugs and spices received from Professor LaWall and Harry E. Sindall.

FLORENCE YAPLE,
Secretary *pro tem.*

FOOD AND DRUG COURSE LECTURE.

The second of the series of special lectures in the Food and Drug Course of the Philadelphia College of Pharmacy for 1908–1909 was given Tuesday, February 9, at 3 o'clock, in the Museum of the College, by Prof. C. B. Cochran, of West Chester, Pa., chemist to the Pennsylvania State Dairy and Food Commissioner. The speaker was introduced by Prof. Samuel P. Sadtler, dean of the Food and Drug Course, and spoke upon the subject, "The First Chapters in the History of Food Adulteration in Pennsylvania."

Professor Cochran contrasted the conditions surrounding the production and transportation of food products forty or fifty years ago with those of the past twenty or twenty-five years, and said that, whereas formerly they were largely the product of domestic or home labor, their production is now in the hands of manufacturers and large commercial concerns. This, he said, had much to

do with their quality, or, as he tersely expressed it, formerly foods were produced to eat, while now they are produced to sell. Then the qualities sought for were taste or flavor, now the qualities most looked for are those which render the articles valuable commercially, such as appearance, yield of product, and stability in transportation.

It was stated that the outlay for foods in the United States is larger than that for any other commodity, and exclusive of the cost of liquors amounts to $2,300,000,000 annually. Foods being articles of daily consumption, there is no other class of commodities, according to Professor Cochran, on which the people in general seek so much to economize. This leads to a demand for cheap products, and the manufacturers endeavor to meet the demand by adulteration and substitution.

The speaker then gave the history of the several food laws of Pennsylvania, including the oleomargarine and lard bills, and the State Food Law of 1895, which latter he said was an excellent law, and all of which were passed and enforced through the combined efforts of the farmers of the state and the Farmers and Dairy Protective Association. That is, as pointed out, these laws were promulgated by those having a business interest in the products, rather than by the consumers, and this, as still further pointed out, appears to have been a conspicuous feature of the history of food legislation in this country.

The statement was made that prior to about 1900 all classes of food products were adulterated, and that often the adulteration was exceedingly gross, after which a number of specific instances of adulteration was mentioned. Of 65 samples of cream of tartar collected at one time for examination, 62 were adulterated. With regard to spices Dr. Cochran said that a great variety of adulterants were used together, sometimes including as much as 25 per cent. of gypsum.

In concluding his address Professor Cochran pointed out the fallacy of buying cheap adulterated foods on the ground of economy, and then spoke deploringly of the baneful influence on the employees of the practices in large manufacturing places where adulteration and substitution are a part of the daily routine work. F. Y.

BOOK REVIEWS.

WELLCOME'S PHOTOGRAPHIC EXPOSURE RECORD AND DIARY 1909. Wellcome's Photographic Exposure Record and Diary for 1909 contains a number of new and interesting features.

The article on exposure contains a large amount of definite information condensed into 28 pages. This is secured by confining attention to points which are of real importance to the photographer in practice.

The illustrations which have been a feature of the book from its first publication, and which have been of such practical service in helping the photographer to make due allowance for his subject in exposure, are now conveniently grouped together on a card carried in the wallet of the book.

Other items in this section of the book are the tables of Exposures for Interiors, Exposures in Telephotography, Exposures for Copying and Enlarging, Exposures for Moving Objects, Exposures for Night Photography, and the well-known list of plate speeds, brought right up to date and, as usual, the most complete list of its kind available.

Wellcome's Photographic Exposure Record and Diary is suitable for use in all quarters of the globe. Its power to calculate exposure correctly has been tested in every continent and in every latitude, from arctic, temperate, subtropical, tropical, to antarctic. For the convenience of users in different parts of the world, three editions are issued: The Northern Hemisphere Edition, for all countries north of the Tropic of Cancer. The Southern Hemisphere and Tropical Edition, for all countries south of the Tropic of Cancer. The United States Edition, for use in the United States of America. When purchasing, care should be taken to specify which edition is required.